9. - 1903

[Reprinted from The Philadelphia Medical Journal, January 21, 1899.]

CONTAGION; ITS MEANING AND ITS LIMITATIONS.

To the Editor of the Philadelphia Medical Journal:—

There is perhaps no question in medicine upon which the profession is so much at sea as that of contagion. There has been so much quibbling about the meaning of the word "contagious," and so many hairsplitting distinctions made between it and the word "infectious," that the general reader of medical literature has become bewildered and is really at a loss to know, when he encounters the words, what is actually meant by them. It may be well, therefore, to again take soundings upon the entire subject and to seek the channels of thought that can be used by all of us so as to bring our observations within reach of common intelligence.

The word contagion is derived from the Latin word contingere, which means to be in contact with, to touch. As applied to diseases it conveys the idea of communicability by contact, from one person to another, from a human being to an animal, from an animal to a human being, or from one animal to another. The communicability must be by contact, direct or indirect, and consequently the environment under which communicability becomes operative must be circumscribed. The *Century Dictionary* defines the word as follows:

> First, infectious contact or communication; specifically and commonly the communication of disease from one person or brute to another. A distinction between contagion and infection is sometimes adopted, the former being limited to the transmission of a disease by actual contact of the diseased part with a healthy absorbent or abraded surface, and the latter to transmission through the atmosphere by floating germs or miasmata. There are, however, cases of transmission which do not fall under either of these divisions and there are some which fall under both. In common use no precise discrimination of the words is attempted.

Webster, in defining the word "contagion," quotes from Dunglison, as follows:

> "The act or process of transmitting a disease from one person to another by direct or indirect contact."

For a second definition he gives:

> "That which serves as a medium or agency to transmit disease; pestilential influence."

In illustration of this meaning he quotes from Shakespeare the following lines:

"And will he steal out of his wholesome bed to dare the vile contagion of the night?"

In his definition of the word "contagious" he says:

"1. (Med.) Communicable by contact; catching; as a *contagious disease*. 2. Containing or generating contagion; pestilential; as *contagious air*. 3. Spreading or communicable from one to another."

Under synonyms he gives:

"Contagious, infectious. These words have been used in very diverse senses; but in general a contagious disease has been considered as one which is caught from another by contact, by the breath, by bodily effluvia and so on; while an infectious disease supposes some entirely different cause acting by a hidden influence like the miasma of prison-ships, of marshes, etc., *infecting* the system with disease. This distinction, though not universally admitted by medical men as to the literal meaning of the words, certainly applies to them in their figurative use. Thus we speak of the *contagious* influence of evil associates; the *contagion* of bad example; the *contagion* of fear, etc., when we refer to transmission by proximity or contact. On the other hand, we speak of *infection* by bad principles, etc., when we consider anything as diffused abroad by some hidden influence."

Gould, in his *Medical Dictionary*, defines "contagion" as

"The process by which a specific disease is communicated between persons, either by direct contact or by means of an intermediate agent."

"Infection" he defines as

"The communication of disease-germs or virus, by any means, direct or indirect."

Thomas's *Medical Dictionary* gives the definition of "contagion" as

"The communication of a disease by contact, or by inhaling the effluvia from one already affected; often used as synonymous with infection."

"Infection," he defines as

"The communication of a disease by personal contact with the sick or by means of effluvia arising from the body of the sick, contagion. The transmission of disease from one individual to another of a different class. The term is sometimes used as synonymous with the contagion, or agent by which a communicable disease is conveyed."

The word "infectious" he defines as

"Contagious; corrupting; that may be easily communicated; capable of transmitting disease; applied to diseases that are capable of transmission from one person to another by contact or by being conveyed through the atmosphere."

The word contagious he defines as

"A term applied to diseases which are spread by contagion or communicated."

In Dunglison's *Medical Dictionary* the word "contagion" is defined as

"Transmission of a disease from one person to another by direct or indirect contact. Also, at one time applied to action of miasmata arising from dead animal and vegetable matter, bogs, fens, etc. Contagious diseases are produced either by virus or contagion, capable of causing them by inoculation, as in smallpox, cowpox, hydrophobia, syphilis, etc., or by miasmata, proceeding from a sick individual, as in plague, typhus gravior, measles, etc. Contagion and infection are generally esteemed synonymous. Frequently, however, the former is applied to diseases not produced by contact, as measles, etc., while infection is used for those that require positive contact, as itch, syphilis, etc. Diseases which are only produced by contagion, are said to have their origin in specific contagion, as smallpox, cowpox, syphilis, etc. Those produced by contagion, and yet supposed to be sometimes owing to other causes, are said to arise from common contagion, as typhus, cynanche parotidaea, etc."

The definitions given in the dictionaries are somewhat obscure and savor of oldtime ideas about the etiology of disease. All, however, agree on certain points, namely: (1) That the word "contagion" has a broader meaning than the word "infection"; and (2) that the words "contagion" and "infection" may be used synonymously. In current literature we frequently find the position of the two words reversed and a limited meaning given to the word "contagion" and a broad meaning to the word "infection."

The word "infection" is derived from the two Latin words in and facere, which mean to carry in something, to make in something. As originally applied, the word meant the carrying of disease from one person to another by a force extraneous to both the disease and the persons giving and receiving the disease. It was principally used to convey the thought that diseases which had their source in miasmatic conditions were wafted by the air and thus communicated to all persons breathing that air; for example, as malaria was carried by the wind from swamps. It had a shade of meaning that well suited certain diseases to which the word "contagious" could not properly be applied.

In the light of the germ-theory of disease we are in a much better position to formulate a clear-cut idea of what is meant by "contagion" and wherein it differs from "infection"; and, oddly enough, we see by it that the key to the true application of the words is to be found in their literal meaning and original application.

Synonymous with "contagion" and "infection" in the adjectival form, are the words "communicable" and "catching." These are generic terms and convey the broad idea of communicability, without any qualification as to method or process by which the end is accomplished. "Contagion" and "infection" are specific terms and convey modified ideas of communicability, each peculiar to itself. "Contagion" conveys the idea of communicability by contact, direct or indirect; the chain of communication between the person giving the disease and the person receiving it being unbroken. "Infection" conveys the idea of communicability through an intermediate agency outside of both the person who gives the disease and the person to whom the disease is conveyed.

The essential features of a contagious disease are: (1) A living organism the parasitic existence of which in a human being or animal constitutes disease; (2) the communicability of that organism from one human being to another, from a human being to an animal, from an animal to a human being or from one animal to another; (3) immediate or mediate contact between a person or animal suffering from the disease and a person or animal free from it; (4) a limited environment under which communicability is operative.

The essential features of an infectious disease are: (1) A living organism the parasitic existence of which in a human being or animal creates disease; (2) the communicability of that organism to human beings and animals; (3) an intermediate agency through which communicability between two hosts or from a non-parasitic habitat to a host can be established.

The difference between the ideas of contagion and infection are: (1) That in contagion the chain of contact between the person giving off the disease and the person receiving it must be complete and unbroken; while in infection the chain of contact must be broken by an intermediate agency; (2) that in contagion the environment under which communicability is operative is limited, while in infection the environment under which communicability is operative, is general.

It is true that in contagion the contact may be mediate, that is through fomites; and that fomites in a sense constitute an intermediate agency; but fomites differ on important points from the intermediate agencies of infection. The intermediate agencies of infection are usually earth, air, or water. Fomites cannot become a soil for the reproduction of organisms that produce contagious diseases, and have no inherent power of transferring them from one host to another; they can only give them shelter until some extraneous force conveys them into the proximity of a prospective host or until chance brings such a host into their vicinity. The intermediate agencies of infection can on the other hand become a soil for the reproduction of the organisms that give rise to infectious diseases, and may possess inherent forces with which to convey such organisms to prospective hosts.

In the category of contagious diseases I would place smallpox, measles, scarlet fever, roseola, influenza, "colds" of various kinds, tonsillitis, chickenpox, whooping-cough, mumps, typhus fever, diphtheria, plague, tuberculosis, leprosy, syphilis, erysipelas, glanders, gonorrhea, septicemia, parasitic skin-diseases, and contagious conjunctivitis. In the category of infectious diseases I would place cholera, typhoid fever, the malarial fevers, yellow fever, dengue, tetanus, enteric parasitic diseases, and possibly pneumonia and carcinoma.

That all of the diseases here enumerated are communicable can scarcely be doubted in the present light of medical science. It has not yet been demonstrated that a living organism is the active and essential cause in all, but we can deduce by analogy, from those in which a living organism has been found to be the active cause to those in which no organism has as yet been identified as the active cause, that a living organism must be the active and essential cause in all. Smallpox, measles, scarlet fever, roseola, chicken-pox, whooping-cough, mumps, typhus fever, plague, syphilis, erysipelas, glanders, yellow fever, dengue, and contagious conjunctivitis are admittedly communicable on clinical evidence alone. In tuberculosis, diphtheria, gonorrhea, septicemia, cholera, typhoid fever, malarial fevers, enteric parasitic diseases, and parasitic skin-diseases the organisms that produce the diseases have undoubtedly been identified; and some of them likewise are admittedly contagious on clinical evidence.

A living organism as an active cause having been discovered in these latter, it may be logically assumed that a similar living organism as an active cause must exist in the others. Like causes produce like effects and like effects must have like causes. Pursuing this line of thought to its logical conclusion we arrive at the proposition that communicability is predicated upon life and that all diseases that are found to be due to a living organism are consequently communicable.

What can thus be reasoned out has already been worked out in detail in the laboratory. In diphtheria and tuberculosis not only have the organisms that give rise to these diseases been discovered, but every step in the process of communicability has been demonstrated. In one of these, diphtheria, the clinical evidence has been in favor of communicability; in the other, tuberculosis, the clinical evidence has generally been against communicability. In both, however, the same fundamental law has been found to exist; namely, that they are due to living organisms and that these organisms are communicated from one host to another under certain well-fixed laws and conditions. It is from the knowledge that we have gathered in the laboratory with regard to tuberculosis and other diseases, together with the clinical knowledge that we possess concerning them, that we are justified in placing those diseases in the class of communicable diseases which have not yet been demonstrated to belong there either at the bedside or in the laboratory.

Into which category a communicable disease should be placed, whether that of a contagious disease or an infectious one, must for the present remain to a great degree a matter of conjecture. When the organisms that give rise to the different diseases have all been identified and their life-histories studied this differentiation will be possible with mathematical accuracy. For the present the order in which I have placed the communicable diseases seems to me to correctly represent our knowledge concerning them as gleaned at the bedside and in the laboratory.

Smallpox is a typical contagious disease; malarial fevers are typically infectious diseases. Between these there are shadings in both directions. If we bear in mind, however, the essential features of the types, and the difference between them, we cannot go far astray in placing all communicable diseases where they belong. I have placed pneumonia and carcinoma among the infectious diseases, rather than among the contagious, for the reason that the environments under which their communicability is operative seems to be general rather than circumscribed. When pneumonia is prevalent in a community it seems to strike people down in all quarters, irrespective of contact; and carcinoma seems to be distributed evenly among all classes and in all parts of a community.

A most important point in the question of contagion is that of limitation. While there are certain laws to which all contagious diseases subscribe, every contagious disease has laws to which it alone is amenable. These laws are dependent upon idiosyncrasies of the organisms giving rise to the diseases and upon the soil that the organisms require for their development and the completion of their cycles of life. For example, smallpox and tuberculosis are both contagious diseases, and conform in all points with the essential features of a contagious disease; but they differ materially in the intensity of their contagion. The organism that gives rise to smallpox finds a congenial soil readily, runs through its cycle of life quickly and exhausts the soil upon which it feeds in a brief period of time. The organism that gives rise to tuberculosis, however, is implanted with considerable difficulty, runs through its cycle of life more slowly and exhausts the soil upon which it feeds most tardily. The organism that gives rise to smallpox escapes from its host almost immediately after the development of the disease and goes out in profuse numbers from every part of the body; while the organism that gives rise to tuberculosis does not escape from its host until the disease has been in progress for a long time, and it escapes by a single avenue. In smallpox the deciduous organism is at once set free in the atmosphere surrounding the host, polluting it and making it intensely infectious, whilst in tuberculosis the deciduous organism is protected by broken-down tissue with which it has to be carried into a new host, and, therefore, it cannot pollute the atmosphere around the host to a very intense degree. The difference in the intensity of contagion between smallpox and tuberculosis, is therefore, great, and the phenomena by which contagion manifests itself are quite different. The essential features of a contagious disease, however, exist in both and are identically the same. In both we have a living organism, the parasitic existence of which gives rise to the specific disease; in both we have communicability of that organism; in both contact, direct or indirect, is essential to communicability; and in both the environment under which communicability is operative is limited.

What is true of smallpox and tuberculosis in regard to individuality of contagion is true of all communicable diseases. Certain groups resemble each other closely, but even in such groups individual members have marked peculiarities. The exanthemata resemble each other closely, all being intense in their contagion and running rapid courses. Leprosy resembles tuberculosis; there is a similarity among the acute diseases of the upper air-passages, such as "colds;" and there is a very close resemblance in the mode of distribution of some of the infectious diseases. As a rule the intensity of contagion or infection is in proportion to the profuseness with which the organism is given off from a host, and inversely to the degree to which the deciduous organism is encumbered in its ingress into a new host. When the deciduous organism is given off through a single channel and is contained in broken-down tissue or newly developed tissue contagion is likely to be mild and erratic.

For preventive purposes a correct classification of communicable diseases and a careful study of the idosyncrasies of each disease are of great importance. With contagious diseases the most important factors to be considered are the host and the prospective host; whilst in infectious diseases the most important factor is the intermediate agency of communication. In contagious diseases we should seek to make the host sterile and the prospective host immune; in infectious diseases we should seek to make the intermediate agency sterile. For example, in smallpox and tuberculosis we have to do (1) with the person suffering from the diseases and (2) with the persons who may be exposed to such a patient; while with cholera and typhoid fever we can accomplish most by looking after the water-supply and the food-supply or after the drainage of our habitations. With all contagious diseases the prospective host is as important a factor from a preventive point of view as the host himself. With smallpox immunity can be established by vaccination, and there is promise in the laboratory-work of the future that similar results may be obtained with all the intensely contagious diseases. With tuberculosis and some of the more mildly contagious diseases partial immunity can be established by the maintenance of a healthy nutrition. Could all the hosts of contagious disease be made sterile or isolated so effectively as to make contact impossible, no new set of hosts could come into existence. In practical life such a condition of things is impossible of attainment; and it, therefore, becomes most important to work at the other end of the line and reduce the number of available hosts to a minimum. With infectious diseases isolation is futile, except in so far as it will aid in preventing the contamination of the intermediate agency of distribution. If every typhoid-fever patient could be isolated and his discharges sterilized, a time would come when all water-supplies would likewise become sterile, and the germs giving rise to the disease would no longer be distributed. Much better results can, however, be attained by at once sterilizing all water-supplies.

In order to be able to understand fully the subject of contagion one must first learn to realize that it is a complex one. With a single idea, based upon what can be observed in smallpox and other intensely contagious diseases, one is bound to become stranded in studying the subject. It is a great and an important subject, and we are as yet merely at its threshold. To gain access to all the secrets that it will reveal to us will require long and tedious study in the laboratory, and careful, conscientious observations at the bedside, with a mind unfettered by traditions and receptive to new ideas. What we know gives us a good hypothetic basis; what we have yet to learn will give us mathematic accuracy.

Respectfully,

LAWRENCE F. FLICK, M.D.

736 Pine Street, Philadelphia.